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HETEROGENETIC DEVELOPMENT IN DIAPTOMUS.

BY C. L. HERRICK.

(Continued from page 389.)

CYCLOPS INGENS Herrick (*Cyclopidæ* of Minn., p. 228, Plate IV, Figs. 1–8).

Found in pools near Tuscaloosa, Ala., with *Daphnia pulex* and *Simocephalus daphnoides*. The post-imago is somewhat over $\frac{1}{10}$ in. long, *i. e.*, not quite as long as *C. gigas* according to Brady, which is very little different. Our form has longer stylets and shorter antennæ in the ordinary stage, but the mature or post-imago has shorter stylets. In the last stage prior to maturity the stylets are just as figured by Brady for this stage. It is worthy of remark that *C. kaufmanni* Uljanin, which is certainly founded upon a prematurely gravid larva (feet being 2-jointed and antennæ undifferentiated) corresponds perfectly with larvæ of *C. ingens*.

Brady himself considers *C. helleri* the same species, and we have here apparently an older stage with fully developed feet but not yet provided with mature antennæ.

A variety of *C. ingens* is found in cold springs at Tuscaloosa and elsewhere in Alabama, much less in size and with the proportions of the European *C. gigas*.

The large examples in shallow "prairie pools" were masked by dense algæ coating. The form of the fifth foot and stylets distinguishes the above from other members of the genus, and one is tempted to regard these forms as varieties of *C. gigas* simply. *C. parcus* (Cyclop. Minn., p. 229) might be considered a var. of *C. ingens*.

CYCLOPS PECTINATUS, sp. nov. (Plate VII, Figs. 25–28).

Related to *C. navus*, from which it is chiefly distinguished by a semicircular series of small spines at the base of the greatly elongated caudal stylets. In the post-imago the stylets are nearly half as long as the abdomen; the antennæ reach nearly to the base of the third segment. In the ordinary adult the stylets are less elongate. In all forms the lateral setæ are one-third from the end and the outer and inner terminal setæ are short spines; the fifth foot is as in Navus and the operculum valves is a little different. Most characteristic, however, is a circlet of small spines one-fourth from the base of the stylets. Length over $\frac{5}{100}$ in.

CYCLOPS TENUISSIMUS, sp. nov. (Figs. 24–25, Plate V; Figs. 20–21, Plate VI).

Section with 17-jointed antennæ.

Extremely elongated; antennæ reaching a little beyond the first thoracic segment, short jointed, formula $-\underline{\smile}\ \smile\ -\underline{\smile}\ \smile - \smile\smile\smile\smile\smile\smile\smile\ \underline{\smile}\ \underline{\smile}\ \underline{\smile}$, the terminal joint rather short, armed with three teeth near the extremity; antennules rather long, last two joints slender; fifth foot 2-jointed, second joint with two nearly equal setæ; cauda stylet, as in *C. tenuicornis*; opening of spermathæca elongated.

This species is the most slender Cyclops known to me, and may be recognized by the toothed terminal joint of the antennæ, a character otherwise confined to *C. tenuicornis*, "coronatus stage."

The teeth of this species differ from those of "Coronatus" too much to confuse the two. This species is of the *navus* and *parcus* group, but the caudal stylets closely resemble *tenuicornis*. Near Paducah, Ky.

CYCLOPS MODESTUS, sp. nov.

Antennæ remaining 16-jointed in all individuals seen, very short, formula — ⏑ — ⏓ ⏑ — ⏑⏑⏑⏑ ⏑⏑ ⏑⏓ — ⏑; antennules short jointed; fifth foot three-jointed, with unequal spines; caudal stylets of moderate length, lateral setæ about half way to base of stylet, three longest terminal setæ subequal.

This is a small species related to the preceding, but differs in many respects, the form of the spermathæca is oval. The egg sacs are slender, elongate oval. Cullman county, Ala.

POST-EMBRYONAL DEVELOPMENT OF TWO SPECIES OF DAPHNIA.

In a previous paper it was shown that the spine found on the posterior portion of the shell in young and male individuals, in all members of this genus, is a persisting embryonal character, and its possible advantage to the economy of the animal was pointed out. It was indicated that a recognition of the facts brought out, would throw several species into synonymy. It is my wish, in this paper, to illustrate the extent of the variations passed through in the course of later development, by two examples, one of which has been but imperfectly described, while the other is new to America.

These two species differ from any known to me, though they may possibly be found among some of Sars' numerous nominal species.

DAPHNIA LONGISPINA Herrick (Microscopic Entomostraca, 1877).

This name was applied to the young, and in connection a figure was given of a male with the spine on the head which, in the female at least, was indicative of immaturity. The name is not particularly appropriate, for the mature female is not evidently spined.

This name has been long applied to another form in Europe, but apparently to an immature stage of another species, so that it is really vacant.

In a paper (Notes on Cladocera of Minnesota) in the Rep. of Geol. Surv. of Minn. 1881, the post-imago is figured, and a variety of the younger stage (a little distorted in the molt). I am now able to complete the chain from the embryo to the post-imago (see

Plate VII). Fig. 3 is the embryo extracted from the brood cavity, showing that the eye is near the extremity of the elongated head even before the two eye spots have united (Fig. 10). Fig. 2 shows the early stage of post-embryonal growth. Fig. 1 is the adult in the first stage in which all the peculiarities of the species are pronounced. Fig. 4 is the post-imago (see also Plate XI Figs. 15–16 of Notes on Minnesota Crust., and Fig. 4 in the text).

DAPHNIA DUBIA, sp. nov.?

This species is very nearly related to the preceding, differing, however, in having the eye small and situated nearly in the center of the head, while the previous one has an eye of usual size and near the straight lower margin. The head is much more acute than in the preceding but not carinated (Fig. 9). Both these species have occasionally a horn in young stages (Fig. 14). The claws are smooth or simply pectinate. The spine in the latter species is more elevated. It is remarkable that the same species has both forms of abdominal appendages represented at Figs. 13 and 8.

The post-imago of *dubia* has not been seen. The nearest approach to it had a considerable spine, but the head had already begun to assume the shorter form with a curved lower margin.

The only allied species yet described from America, is *D. lævis* of Birge in which the development is tolerably well completed.

By filling up the gaps till all the stages in each case are known, we have advanced one step toward an accurate determination of species, and require then to learn what variations in the process usually obtaining may be occasioned by alterations in the environment. But in the mean time we are discovering the laws which govern development and the historical affinities of the different genera and species.

DAPHNIA PULEX.

This common species is subject to variations which are perplexing, but there seems to be no reason for the separation of the var. *denticulata*, as done by Birge. The differences relied upon are the fine teeth down the claw and the abrupt curvature of the lower margin of the head. Fig. 4 of Plate I in P. E. Mueller's work figures this peculiarity of the claws. Quite typical *D. pulex* from Tuscaloosa, however, do not have the fine teeth and only 12–15 teeth on the abdomen.

SCAPHOLEBERIS ANGULATA, sp. nov. (Figs. 26–28, Plate V).

The genus Scapholeberis at present consists of two species, *S. nasuta* Birge,[1] and *S. mucronata* with its three varieties *(a) fronte lævi*, *(b) fronte cornuti* of Europe, and *(c) armata*,[2] found in Minnesota, Illinois and Tennessee. With regard to the European varieties it is remarkable that although they are not local varieties,[3] the horn upon the head appears in the larger individuals and not as would be expected from the analogy of Daphnia, in young and small individuals. However, it is to be noticed that the spines of the valves in Scapholeberis are not persisting embryonic characters like the spine in Daphnia, but the young are like Ceriodaphnia. It may be that in like manner the crest upon the head in Scapholeberis is, instead of an embryonic appendage as in Daphnia, a later production. It might then be suggested that Scapholeberis is now undergoing differentiation or, in other words, is a new genus historically, while Daphnia is past the acme of its activity in the direction in which it has differentiated, and now retains its peculiarities by inheritance, and tends to continue them only so far as they are of functional value.

The horn which sometimes appears in young of certain species of Daphnia (*D. galeata*) and seems so capricious in its production, may be not unlike that of this species.

Were it not that *S. mucronata* is known to be very variable, it might be admissible to create var. *armata* a new species. Additional details are given for this variety in Figs. 23–24, Plate VI.

Scapholeberis angulata, sp. nov.—Head of medium size; rostrum directed downward and backward; eye of moderate size; macula nigra indistinct; formices and basin for antennæ well developed; antennules long curved, armed with two lateral sense hairs as well as the terminal olfactory? filaments; cephalic portion of the basin of antennæ marked by longitudinal lines connected at intervals by cross lines, inferior portion of the part of the basin on the valves reticulate; "mucro" absent, the inferior posterior corner of shell simply sharply angled; inner wall of shell furnished with a row of small spines below and posteriorly for a part of the height of the shell; caudal teeth 5–7 in adult, being more numerous than in any other known species; size large.

The "mucro" is absent in the smallest individuals seen. Scapholeberis seems to lie between Daphnia and Ceriodaphnia, agreeing with the former in being a divergent member of the family, but still with more affinities to the latter. Near Decatur, Ala.

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[1] Birge. Notes on Cladocera.

[2] Herrick. Notes on Crustacea of Minnesota, Geol. Rep. 1881.

[3] Kurz. Doclekas neuer Cladoceren, etc., p. 22.

SIMOCEPHALUS DAPHNOIDES, sp. nov. (Figs. 30, 31, Plate V; Fig. 16, Plate VI).

Four nominal species of Simocephalus are described: *S. vetulus* Müller, *S. expinosus* Koch, *S. serrulatus* Koch, *S. americanus* Birge. The differences in some cases seem quite trivial, since the form of the *macula nigra* certainly varies with age along with the shape and armature of head and the general shape of the body. However, the present species is so unmistakable that it is not requisite to enter upoa a discussion which lack of material makes undesirable.

Simocephalus daphnoides, sp. nov.—General shape very like Daphnia; head regularly curved and not strongly angled in front, not marked off from the body by a strong depression; eye of moderate size, macula nigra oval to rhomboidal; antennules long curved; anterior portion of shell as deep as the posterior; the three curved spines at the lower posterior angle of shell are wanting; abdomen much as in *S. vetulus;* claw fringed part way with weak spines.

This species is recognized by its oval shape and the Daphnia-like shape of head. In old females the spine is about midway of the depth of the shell, but the upper outline is regularly curved and not keeled as in *vetulus* (Fig. 29, Plate V). Quite characteristic is the absence of the three or four curved spines on the shell angle (comp. Fig. 31 with 29*a*). On the whole in this species an approach to Daphnia may be seen. Near Decatur, Ala., with *Scapholeberis angulata*, also in all Southern Alabama.

CERIODAPHNIA ALABAMENSIS, sp. nov. (Figs. 11–12. Plate VI).

Ceriodaphnia is a very perplexing genus, and one in which the effect of age has not been studied. Three species have been mentioned from America, *C. cristata* Birge, *C. consors* Birge, and *C. reticulata* (= *dentata* Birge), there remaining *pulchella*, *rotunda*, *punctata*, *laticauda (?)* and *quadrangulata*, as described in Europe.

Quite typical *C. reticulata* were collected back of Paducah, Ky. The peculiar shape of the fornices figured by P. E. Mueller can be produced by pressure. I have little doubt that this is the same animal described from Massachusetts and Wisconsin by Birge. The head is not so suddenly angled behind the eye as figured by Birge, but more so than represented by Mueller.

C. alabamensis, sp. nov. — The form for which this name is offered, is known from a single gathering at Tuscaloosa, Ala., but it differs from any known species so much as to leave no doubt that it is a new species. A complete diagnosis unfortunately cannot be given.

Head remarkably small and produced downward; eye very small; the head extends into a beak-like prolongation below the eye; the antennules are very long and pendant as in Moina; the body is longer than in *reticulata*, and the reticulations have a double contour line as in *C. pulchella;* the abdomen is slender and the sides nearly parallel, the claws being short and truncate, the spines of the usual size. Two summer eggs were in the cavity of the animal figured.

A fifth species of Ceriodaphnia was found in cold springs near Tuscaloosa, Ala., which is not greatly different from *C. reticulata* as defined by P. E. Mueller and Kurz.

CERIODAPHNIA (*reticulata* var.) PARVA, sp. (vel var.) nov.

$\frac{23}{1000}$–$\frac{25}{1000}$ in. long, transparent; head not strongly depressed, somewhat abruptly angled in front of antennules; fornices not very prominent; antennules short, conical, shell oblong, ending in a sharp angle posteriorly, simply reticulated; abdomen rather short, not narrowed very much, distally rounded at the extremity; claws rather short, smooth, spines short curved.

This very small species was found in considerable numbers, but very little variation in size was noticed. *C. pulchella* Sars, is 0.5–0.6^{mm}, but the head is quite different, though the abdomen is similar. Kurz says also, "Die schalensculptur ist doppel-linig," which is not the case in our species.

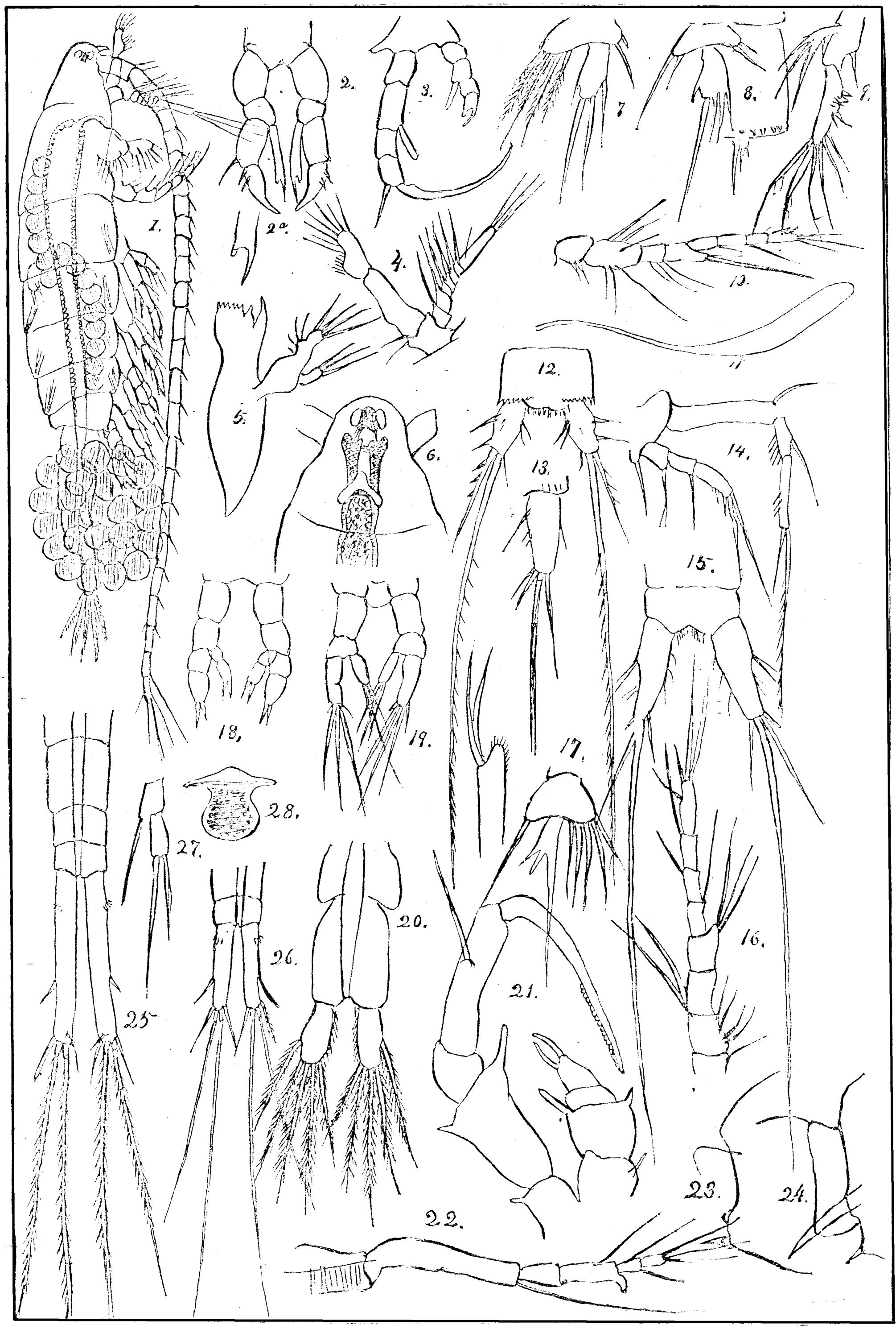
C. quadrangula is 0.6^{mm}, but several important differences are observable between the two species. In that species the head is said to be "valde depressum, ante basin antennarum ferme non angulatum;" the antennules are large and the abdomen narrow.

In general appearance this species is a reduced copy of *C. reticulata*, but the claws are smooth. Kurz speaks of a small var. of *reticulata* with smooth claws, but the fornices are then said to be sharp.

EXPLANATION OF PLATE VII.

FIG. 1.	*Diaptomus pallidus*,	female.
" 2.	"	fifth feet of female.
" 3.	"	fifth feet of male.
" 4.	"	antennules.
" 5.	"	mandible.
" 6.	"	head.
" 7.	*Canthocamptus*, sp. n. ?	fifth foot of female.
" 8.	"	fifth foot of male.
" 9.	"	antennules.
" 10.	"	antenna of female.
" 11.	"	spermathæca.
" 12.	"	stylets of female.
" 13.	"	stylet of male.
" 14.	"	maxilliped.

PLATE VII.



Heterogenetic Development in Diaptomus.

FIG. 15. *Canthocamptus*, sp. n., stylets of female.
" 16. " antenna.
" 17. " fifth foot of female.
" 18. *Diaptomus* "*sanguineus*," fifth feet of larva (♂).
" 19. " fifth feet of larva (♀).
" 20. " abdomen of larva (♀).
" 21. " fifth foot of adult (♂).
" 22. " antenna of adult.
" 23. *Diaptomus* "*castor*," margin of last segment (♂).
" 24. " margin of last segment (♀).
" 25–28. *Cyclops pectinatus.*
" 29. *Diaptomus pallidus*, inner ramus of fifth foot (♀.)

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REMARKS ON THE MORPHOLOGY OF ARTERIES, ESPECIALLY THOSE OF THE LIMBS.[1]

BY FRANK BAKER, M.D.

IT is generally taken for granted that the variability of arteries is such that they are of but little use in morphological studies. Anatomists are usually of the opinion that since the function of the arteries is to nourish the tissues, their course from the heart to their destination is of too slight importance to the race to have become a fixed character, and all search for law is abandoned. But it is questionable whether some biologists have not too hastily come to this conclusion.

Morphological laws are always obscure when studied in the adult individual alone. To trace them we must examine the different phases of individual development and investigate the anatomy of related forms.

There is a period when the embryo of a vertebrate animal is not provided with a proper vascular system. During the early stages of the segmentation of the ovum, no vessels exist, the young cells receiving the necessary nutriment from an interstitial plasma, as do those of the lowest Protozoa.

This stage is of short duration. Throughout the minute disk-shaped object which is hereafter to be a fully developed vertebrate, certain cells appear, of a slightly reddish color, dotting the disk in a peculiar marbled manner. From their appearance and isolation these are known as *blood-islands*. They touch each other finally as they increase in number, either at some part of

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[1] Abstract of a paper read before the Montreal meeting of the Amer. Assoc. for the Advancement of Science.